



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RADIATION AND INDOOR AIR
National Air and Radiation Environmental Laboratory
540 South Morris Avenue, Montgomery, AL 36115-2601
(334) 270-3400

April 17, 2012

MEMORANDUM

SUBJECT: Radiochemical Results for
Dimock Residential Groundwater Site Samples

FROM: Cindy White, Acting Director *Cindy White*
Center for Environmental Radioanalytical Laboratory Science

TO: Fred Foreman, Chief
Technical Services, Region 3

Attached is a data package for radium-226 analysis of samples collected from the Dimock Residential Groundwater Site in Dimock, PA. The samples constitute NAREL batch number 1200002. The results of further analyses will be sent as they are completed.

Radiochemical analyses usually require the subtraction of an instrument background measurement from a gross sample measurement. Both values are positive, but when the sample activity is low, random variations in the two measurements can cause the gross value to be less than the background, resulting in a measured activity less than zero. Although negative activities have no physical significance, they do have statistical significance, as for example in the evaluation of trends or the comparison of two groups of samples.

For all analyses, it is the policy of NAREL to report results as generated, whether positive, negative, or zero, together with the 2-sigma measurement uncertainty and a sample-specific estimate of the minimum detectable concentration (MDC). The activity, uncertainty, and MDC are given in the same units.

Specific information concerning all aspects of the radiological analysis of the samples is contained in the batch case narratives of the data packages. If you have any questions concerning the analytical results, please contact me at (334)270-7052.

Attachments

cc: John G. Griggs, NAREL

**U.S.ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY
540 S. MORRIS AVE., MONTGOMERY, AL 36115
RA226 ANALYSES**

REPORT OF SAMPLE DELIVERY GROUP #1200002

Project: Dimock Residential GW Site, Dimock, PA
Analysis method: Radium-226 in Water: Rapid Method for High-Activity Samples
Report ID: 1200002-RA226
Report type: Original
Date reported: 04/12/2012
Total pages in report: 18

SAMPLES

NAREL Sample #	Client Sample ID	Location	Matrix	Date Collected	Date Received
B2.02559T	FB19	PA:DIMOCK	WATER-DRINKING	03/05/2012	03/07/2012
B2.02560K	HW56	PA:DIMOCK	WATER-DRINKING	03/05/2012	03/07/2012
B2.02561L	HW60	PA:DIMOCK	WATER-DRINKING	03/05/2012	03/07/2012
B2.02617K	FB20	PA:DIMOCK	WATER-DRINKING	03/06/2012	03/08/2012
B2.02618L	HW61	PA:DIMOCK	WATER-DRINKING	03/06/2012	03/08/2012
B2.02619M	HW61Z	PA:DIMOCK	WATER-DRINKING	03/06/2012	03/08/2012
B2.02675W	FB21	PA:DIMOCK	WATER-DRINKING	03/08/2012	03/09/2012
B2.02676X	HW50	PA:DIMOCK	WATER-DRINKING	03/08/2012	03/09/2012

EXCEPTIONS

1. **Packaging and shipping** – No problems were observed.
2. **Documentation** – No problems were observed.
3. **Sample preparation** – No problems were encountered.
4. **Analysis** – No problems were encountered.
5. **Holding times** – No holding times were specified.

QUALITY CONTROL

1. **QC samples** – All QC analysis results met NAREL acceptance criteria.
2. **Yields** – All chemical yields were within acceptance limits.
3. **Instruments** – Response and background checks for all instruments used in these analyses met NAREL acceptance criteria.

CERTIFICATION

I certify that this data report complies with the terms and conditions of the Quality Assurance Project Plan, except as noted above. Release of the data contained in this report has been authorized by the Director of the Center for Environmental Radioanalytical Laboratory Science and the NAREL Quality Assurance Manager, or their designees, as verified by the following signatures.

Mary F. Wisdom

Mary F. Wisdom
Quality Assurance Manager, NAREL

4-16-12

Date

for
John G. Griggs (Acting CERLs Dir)

John G. Griggs, Ph.D.
Director, Center for Environmental Radioanalytical
Laboratory Science

4-17-12

Date

GENERAL INFORMATION

SAMPLE TYPES

BLD	Blind sample
FBK	Field blank
SAM	Normal sample

ANALYSIS QC TYPES

ANA	Normal analysis
DUP	Laboratory duplicate
LCS	Laboratory control sample (blank spike)
MS	Matrix spike
MSD	Matrix spike duplicate
RBK	Method blank

QUALITY INDICATORS

RPD	Relative Percent Difference
%R	Percent Recovery
Z	Number of standard deviations by which a QC measurement differs from the expected value

EVALUATION OF QC ANALYSES

A method blank result is considered unacceptable if it is more than 3 standard deviations below zero or more than 3 standard deviations above a predetermined upper control limit. For some analyses NAREL has set the upper control limit at zero. For others the control limit is a small positive number.

NAREL evaluates the results of duplicate and spike analyses using "Z scores." A Z score is the number of standard deviations by which the QC result differs from its ideal value. The score is considered acceptable if its absolute value is not greater than 3.

The Z score for a spiked sample is computed by dividing the difference between the measured value and the target value by the combined standard uncertainty of the difference.

The Z score for a duplicate analysis is computed by dividing the difference between the two measured values by the combined standard uncertainty of the difference. When the precision of paired MS/MSD analyses is evaluated, the native sample activity is subtracted from each measured value and the net concentrations are then converted to total activities before the Z score is computed.

Each standard uncertainty used to compute a Z score includes an additional fixed term to represent sources of measurement error other than counting error. This additional term is not used in the evaluation of reagent blanks.

NAREL reports the "relative percent difference," or RPD, between duplicate results and the "percent recovery," or %R, for spiked analyses, but does not use these values for evaluation.

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

ANALYSIS SUMMARY

Analysis Procedure: NAREL RA226-EICHROM
Title: Radium-226 in Water: Rapid Method for High-Activity Samples

NAREL Sample #	QC Type	Preparation Procedure	Date Completed	Assay Batch #	QC Batch #
B2.02559T	DUP	N/A	04/12/2012	0015881X	0008634F
B2.02560K		N/A	04/12/2012	0015881X	0008634F
B2.02560K		N/A	04/12/2012	0015881X	0008634F
B2.02561L		N/A	04/12/2012	0015881X	0008634F
B2.02617K		N/A	04/12/2012	0015881X	0008634F
B2.02618L		N/A	04/12/2012	0015881X	0008634F
B2.02619M		N/A	04/12/2012	0015881X	0008634F
B2.02675W		N/A	04/12/2012	0015881X	0008634F
B2.02676X		N/A	04/12/2012	0015881X	0008634F
LCS-00635349F *	LCS	N/A	04/12/2012	0015881X	0008634F
RBK-00635350Y *	RBK	N/A	04/12/2012	0015881X	0008634F

* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

PREPARATION METHOD(S) USED

Procedure ID	Title

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02559T	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	Aqueous		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS81	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	4.11e-02	6.3e-02	8.8e-02	PCI/L	04/10/2012 13:57 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02560K	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS82	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	5.44e-01	2.0e-01	1.1e-01	PCI/L	04/10/2012 13:54 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02560K	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	DUP
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS83	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226 *	3.80e-01	1.6e-01	1.1e-01	PCI/L	04/10/2012 14:06 CDT

* An asterisk indicates a result that may be significantly under or overestimated

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02561L	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS84	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226 *	1.56e+00	3.3e-01	9.8e-02	PCI/L	04/10/2012 13:55 CDT

* An asterisk indicates a result that may be significantly under or overestimated

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02617K	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	Aqueous		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS85	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	1.70e-01	1.2e-01	1.1e-01	PCI/L	04/10/2012 14:05 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02618L	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS86	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	1.43e-01	1.0e-01	6.9e-02	PCI/L	04/10/2012 14:00 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02619M	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS87	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	2.56e-01	1.9e-01	2.1e-01	PCI/L	04/10/2012 14:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02675W	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	Aqueous		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS88	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	4.57e-02	7.1e-02	1.1e-01	PCI/L	04/10/2012 14:09 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	B2.02676X	QC batch #:	0008634F
Matrix:	WATER-DRINKING	Assay batch #:	0015881X
Sample type:	SAM	Prep procedure:	N/A
Amount analyzed:	2.000e-01 L	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS89	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	5.77e-01	1.9e-01	6.2e-02	PCI/L	04/10/2012 14:15 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	LCS-00635349F	QC batch #:	0008634F
Matrix:	N/A	Assay batch #:	0015881X
Sample type:	N/A	Prep procedure:	N/A
Amount analyzed:	1.000e+00 SAMP	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	LCS
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS90	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	3.20e+00	2.8e-01	2.1e-02	PCI	04/10/2012 14:12 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG #1200002

SAMPLE ANALYSIS REPORT

Sample #:	RBK-00635350Y	QC batch #:	0008634F
Matrix:	N/A	Assay batch #:	0015881X
Sample type:	N/A	Prep procedure:	N/A
Amount analyzed:	1.000e+00 SAMP	Analysis procedure:	NAREL RA226-EICHRO
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	RBK
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/11/2012 15:04	1000.0	AS92	RCL

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Date
Ra226	2.11e-02	1.8e-02	1.9e-02	PCI	04/10/2012 14:04 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY**

SDG 1200002

QC BATCH SUMMARY

QC batch #: 0008634F
Preparation procedure: N/A
Analysis procedure: NAREL RA226-EICHROM

NAREL Sample #	QC Type	Yield (%)	$\pm 2 \sigma$ Uncertainty (%)	Analyst
B2.02559T	DUP	92.13 %	6.99 %	VH
B2.02560K		87.81 %	6.77 %	VH
B2.02560K		97.92 %	7.34 %	VH
B2.02561L		96.01 %	7.23 %	VH
B2.02617K		89.41 %	6.93 %	VH
B2.02618L		93.42 %	7.17 %	VH
B2.02619M		50.47 %	4.63 %	VH
B2.02675W		92.44 %	7.01 %	VH
B2.02676X		95.89 %	7.17 %	VH
LCS-00635349F *	LCS	105.67 %	7.72 %	VH
RBK-00635350Y *	RBK	93.44 %	6.96 %	VH

* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

**National Air and Radiation Environmental Laboratory
QC Batch Report**

QC Batch #: C008634F

Analytical Method: NAREL RA226-EICHROM

METHOD BLANKS (PCI)

Sample ID	Nuclide	Activity $\pm 2\sigma$	Prep Date	Flags
00635350Y	RA226	$2.11\text{e-}02 \pm 1.8\text{e-}02$	2012-04-10	OK

LABORATORY DUPLICATES (PCI/L)

Sample ID	Nuclide	Original $\pm 2\sigma$	Duplicate $\pm 2\sigma$	RPD	Z
B2.02560K	RA226	$5.44\text{e-}01 \pm 2.0\text{e-}01$	$3.80\text{e-}01 \pm 1.6\text{e-}01$	35.56	-1.30 OK

LAB CONTROL SAMPLES (PCI)

Sample ID	Nuclide	Amt Added $\pm 2\sigma$	Measured $\pm 2\sigma$	%R	Z
00635349F	RA226	$3.37\text{e+}00 \pm 3.4\%$	$3.20\text{e+}00 \pm 2.8\text{e-}01$	95.12	-1.08 OK

Analyst:

Velinda Herbert
Herbert, Velinda

4/12/11 *4/12/12*

QA Officer:

John White (AI+QA officer) *4-12-12*

Method Blanks

Analyte: RA226

Method: NAREL RA226-EICHROM

Analyst: Herbert, Velinda

Report: 1200002-RA226

